



Industry Academia Partnership Programme (IAPP) South Africa-UK

Feb. 4 – 6, 2019

Department of Chemistry

Chemical Sciences Building

University of the Western Cape

Cape Town, South Africa



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WESTERN CAPE



Delivery of training in Carbon Capture and Storage for industry-oriented projects

The project aims to establish the basis for a long-lasting cooperation and exchange of expertise between the UK and South African academe and industry in the field of carbon capture and storage (CCS). By meeting the goals and objectives detailed in the project proposal we aim to establish this consortium as a leader in worldwide efforts to provide the support and tools to enable researchers, industry and government in South Africa (SA) to identify possible energy scenarios involving the deployment and full realization of the full potential of CCS technology.

The goals and objectives are to deliver a structured training programme in CCS, including theoretical, numerical and experimental training activities, from leading UK academics and international industry partners to the Engineering Faculty, University of the Western Cape, South Africa, in the area of CCS.

- To build research capacity in the Partner Country's University of the Western Cape
- To engage UK research expertise in solving industry problems in the Partner Country and add value to its research progress and industrial operations.

The intention is to transfer acknowledged competence in CCS from the UK to SA institutions, and to contribute towards capacity building in the field of carbon dioxide capture and storage and promote the technology as one possible scenario in the government's GHG pledge



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Welcome

It is our great pleasure to welcome you to the “Carbon Capture & Storage workshop 2019” scheduled on 4-6 Feb. 2019 hosted by the Department of Chemistry at University of the Western Cape.

This workshop is a joint effort of the University of the Western Cape and UK Academia and industry under Industry Academia Partnership Programme (IAPP) funded by the Royal Academy of Engineering. The project aims to establish the basis for a long-lasting cooperation and exchange of expertise between the UK and South African academia and industry in the field of Carbon Capture and Storage (CCS). The main objective of this partnership is to transfer carbon capture competence to South African institutions and to contribute to further development to competence and focus on CCS.

This workshop will offer a series of informative plenary and technical presentations that will provide an overview of carbon capture and storage technologies and recent research progress. The workshop will deliver a structured training programme in CCS, including theoretical, numerical and experimental training activities, from leading UK academics and international industry partners to the Science Faculty, University of the Western Cape, South Africa in the area of CCS aiming to build research capacity in the partner Country’s universities and to engage UK research expertise in solving industry problems in the Partner Country and add value to its research progress and industrial operations

Organising Committee

Salam Titinchi, University of the Western Cape, South Africa

Seyed Shariatipour, Coventry University, UK

	Monday, 4 Feb	Tuesday, 5 Feb	Wednesday, 6 Feb
9:00 - 9:15	Opening welcome	Paul Eke	Bagus Muljadi
9:15 - 9:30	Michael Davies-Coleman , Dean Faculty of Natural Sciences	Technical Overview of Carbon Capture and Storage Technologies	Multiscale Modelling of Flow and Transport in Porous Media
9:30 - 9:45	Short introduction on the program		
9:45 - 10:00	Seyed Shariatipour /Salam Titinchi		
10:00 - 10:15	A D Surridge SA CCS Genesis	Kelvin Yoro Mass Separating Agent Targeting during CO ₂ Capture Using an Improved Mass Integration Technique	Moses Magoba Petrophysical evaluation and substitution modelling of the Upper shallow Marine sandstone reservoirs in the Bredasdorp Basin, SA
10:15 - 10:30	N Kamrajh Pilot Storage Project -	Alexandros Tasianas	Eric Mackay
10:30 - 10:45	Wiseman Ngcobo PCSP Stakeholder Engagement -	Geological model building methodology: Snøhvit site, Barents Sea.	Interactions between CO ₂ Storage Sites and other Users of Subsurface Formations
10:45 - 11:00	E Nyandoro General CCS - E		
11:00 - 11:30	Break	Break	Break
11:30 - 11:45	Cornel Hart Postgraduate Student Orientation:	Bagus Muljadi Multiscale Modelling of Flow and Transport in Porous Media	Paul Eke Risk Mitigation: Engineering Strategies for CO ₂ Injection into Geological Formations.
11:45 - 12:00	Eric Mackay		
12:00 - 12:15	Management of Subsurface CO ₂		
12:15 - 12:30	Storage Sites to Maximise Storage Capacity and Security: Case Examples	Nehemiah Dominick Reservoir Characterisation for Carbon Capture storage: Case Study of the Orange Basin	Jade Holtman Geological Modelling for Carbon Storage Opportunities in the Orange Basin South Africa
12:30 - 12:45			
12:45 - 13:45	Lunch	Lunch	Lunch
13:45 - 14:00	Maxwell Amponsah-Dacosta	Ray Everson	Mimonitu Opuwari
14:00 - 14:15	Fault Seal Analysis for Carbon Dioxide Storage within Offshore Pletmos Basin, South Africa.	Carbon dioxide capture using circulating fluidized bed technology involving sorbent characterization and process development.	The Unique Petroleum Geology Program, University of the Western Cape South Africa
14:15 - 14:30	Alexandros Tasianas CO ₂ leakage and environmental risk assessment from offshore pipelines	Tshiamo Moleele Investigation of the carbon storage potential of the Sundays River Trough in the Algoa Basin	Closing remarks: Seyed Shariatipour
14:30 - 14:45		Seyed Shariatipour	Visit to Hive
14:45 - 15:00		Top surface morphology of CO ₂ storage formations and its impact on the plume migration	(Highly Immersive Visualization Environment)
15:00 - 15:15			
15:15 - 15:45	Break	Break	
15:45 - 16:00	Alexandros Tasianas	Salam Titinchi	
16:00 - 16:15	CO ₂ leakage and environmental risk assessment from offshore pipelines	Carbon dioxide: Capturing to Utilisation	
16:15 - 16:30			

Management of Subsurface CO₂ Storage Sites to Maximise Storage Capacity and Security: Case Examples

Eric Mackay

Heriot-Watt University & SCCS, E.J.Mackay@hw.ac.uk

Successful storage of CO₂ in the subsurface entails satisfying various objectives. Key amongst these are maintaining injection into rock formations at target rates for the duration of the project, and ensuring (and demonstrating) that the CO₂ has and will remain within the designated storage complex. To achieve these objectives requires accurate description of the subsurface, modelling of the injection and migration of CO₂ and monitoring of the site. This talk will use examples from field scale projects to describe how injection and migration are modelled, using previously constructed geological models as underpinning, and providing predictions that can then be verified by various monitoring techniques. We will concentrate on the flow modelling, and illustrate how injection is calculated and the factors that may impact injectivity. We will also address propagation of CO₂ and modelling of mechanisms that lead to CO₂ trapping, and how these impact storage security.

Eric Mackay
Heriot-Watt University & SCCS



Eric Mackay holds the Energi Simulation Chair in Reactive Flow Simulation in the Institute of Petroleum Engineering at Heriot-Watt University, where he has worked since 1990. His research interests include the study of fluid flow in porous media, such as the flow of oil, gas and water in subsurface geological formations. He has over 150 publications related primarily to maintaining oil production when faced with mineral scale deposition, but since 2005 he has also worked on Carbon Capture and Storage, and is currently a member of the Scottish Carbon Capture and Storage (SCCS) directorate. He is involved in projects investigating secure CO₂ storage in saline formations and depleted hydrocarbon reservoirs, and has co-edited one book and authored a chapter in another book on this topic. Eric holds a BSc in Physics from the University of Edinburgh and a PhD in Petroleum Engineering from Heriot-Watt University.

Background of CCS in South Africa and the Technical Development Programme

A D Surridge, E Nyandoro, T Maupa, W Ngcobo

South African National Energy Development Institute

Carbon Capture and Storage (CCS) was introduced to South Africa during 2002 as an optional technology to mitigate carbon dioxide emissions (CO₂) into the atmosphere. During 2009, the South African Centre for Carbon Capture and Storage (SACCCS) was established as a division of SANEDI. During 2012, Cabinet endorsed the Road Map for the technical development of CCS in South Africa. Starting from a zero base, the CCS programme has progressed to the extent that the site characterisation for a Pilot CO₂ Storage Project (PCSP) will commence field work during 2019.

This paper will outline:

- The genesis, mandate and infrastructure of CCS in South Africa;
- The PCSP as a “proof of concept” and capacity building;
- The PCSP stakeholder engagement programme; and
- The CCS mainstream work that includes; C Capture, Industry Requirements, Mineralisation, Utilisation, C Tax, Non-Climate Change Impacts.

A D (Tony) Surridge

B.Sc., M.Sc., Dip.E., Ph.D., F.Inst.P.(Lon)

South African National Energy Development Institute

Dr Surridge was educated at Canterbury University and University of Otago in New Zealand. After a short service at the Department of Scientific and Industrial Research, he moved to the CSIR during 1979 where he served until 1989. After four years in the private sector, he moved to the Department of Minerals and Energy during October, 1993.



Dr Surridge was engaged by the South African Department of Minerals and Energy, first as a Deputy Director and then from April 1995 as a Director. He was responsible for matters related to electricity, renewable energy, environment, energy efficiency, energy database, coal and gas and petroleum. He drafted South Africa's first National Integrated Energy Plan, inter alia drafted four pieces of legislation, negotiated a number of international agreements, and represented South Africa at numerous international gatherings including the United Nations Framework Convention on Climate Change.

Since December 2006, Dr Surridge is General Manager - Cleaner Fossil Fuel Use at the South African National Energy Development Institute. During 2009, he established and is currently the Head of the South Africa Centre for Carbon Capture and Storage.

Thulani Maupa

Pr.Sci.Nat, BSc (Hons), GDE

South African National Energy Development Institute

Mr. Thulani Maupa is currently the Technical Lead: PCSP at SACCCS since March 2015. He holds a BSc Honours and Graduate Diploma in Engineering (GDE) both from the University of the Witwatersrand, and also a Leadership Development Programme certificate from the University of Stellenbosch.



He started his career at the then JCI as a Geologist at the South Deep Gold Mine, where he worked as a Structural Geologist. In 2001 he moved to Sasol Mining in Secunda, starting first at the Exploration Division where in 2002-03 achieved an Excellence award as part of the Directional Drilling Department. He then moved to Middelbult Colliery where he was responsible for implementing directional drilling in an underground section, at first for Sasol Mining.

Between 2007 and 2013 he was the Geology Manager at CoAL, responsible for setting up an exploration programme for Makhado and Vele Colliery projects in Limpopo Province with the latter developing into a mining operation producing Semi-Soft Coking Coal for export.

He is currently responsible for the implementation of the Pilot CO₂ Storage Project (PCSP) with the main focus in identifying suitable geological storage in the Zululand geological basin in Northern KwaZulu-Natal Province of South Africa. He has served as a referee for several journals and for the AiF, DFG and AvH foundation. From 2001-2005 he served as the dean of studies at the Technical Faculty.

Wiseman (Wiyz) Ngcobo

B Tech

South African National Energy Development Institute

Mr Wiseman (Wiyz) Ngcobo is responsible for Stakeholder Engagement at South African Centre for Carbon Capture & Storage (SACCCS), a division of the South African National Energy Development Institute (SANEDI). His responsibilities include inter alia to engage with vast stakeholders at the National, Provincial and Local levels; positioning the brand of SACCCS (both internationally and locally) as well as raise awareness about Carbon Capture and Storage (CCS) in general. He obtained a BTECH Degree in Public Relations Management from the Cape Peninsula University of Technology (CPUT).



He has experience in Marketing, Public Relations, Communications, Media Relations, Business Development, Lobbying and Fundraising gathered from the industry and NGOs, spanning more than twelve (12) years. He completed an online course on Climate Change Science and Negotiations offered by the Sustainability Development Solutions Network Education. Prior to joining SANEDI/SACCCS, Wiseman contributed to the success of the Community Chest Twilight Team Run 2012, Carnival 2012, Deaf International Month/Day as well as other auspicious events. He managed the Public Relations Department at the Deaf Federation of South Africa (DEAFSA). In this role, he introduced the Capacity Building initiatives for beneficiaries and raised adequate funds for the projects thereof.

Evelyn Nyandoro

B Sc (Hons) Economics

South African National Energy Development Institute

Evelyn Nyandoro holds a degree in Economics and a Project Management course from Milpark business school.



She joined the then SANERI (South African National Energy Research Institute) during August 2007 as a research assistant. She reported to the senior manager for Cleaner Fossil Fuels as well as the senior manager for Clean Energy (Renewables). She was promoted to Project Coordinator to provide support to the SACCCS Manager in project management and coordination of project related activities.

Ms Nyandoro was part of the team that worked on the public/private collaborative projects like the South African Coal Roadmap and the South African Geological Atlas led by the Council for Geosciences. She has coordinated and managed the hosting of two successful conferences namely the 3rd South African CCS Conference 2013 held at Cedar Park Hotel in Sandton and the 4th South African CCS Conference 2015 held at Capitol 20 West Hotel titled “Capacitating South Africa for CCS”.

Evelyn Nyandoro is currently the Manager for the South African Centre for Carbon Capture and Storage (SACCCS) and is responsible for the technical development and stakeholder engagement of CCS in South Africa.

Postgraduate Student Orientation: Division of Postgraduate Studies (DPGS)

Cornel Hart

University of the Western Cape

Cornel Hart is the Manager: Division of Professional Development and External Relations (DPDER) at the School of Postgraduate Studies, University of the Western Cape.



Since 2007 Hart has helped UWC students learn to facilitate community initiatives, coordinate interactions with communities, promote change and sustainable community ownership and conduct research in communities to facilitate and inform a participatory processes for improved wellbeing and quality of life.

Due to her contributions, and dedication to community development efforts, Hart had won the inaugural International Community Development Practice Award from the Community Development Society (CDS).

Hart's current Community Development engagements are geared towards sharing the South African Professionalization process as a model for countries with the same intentions and she therefore became part of a working group of the International Association for Community Development (IACD) and CDS.

Cornel does research in Community Development, Qualitative and Quantitative Well-being and Social Capital Research. Her current research and efforts focus on partnership establishment towards achieving the objectives of National, Regional and International Development Strategies for improved quality of life.

CO₂ leakage and environmental risk assessment from offshore pipelines (Northern Lights Project)

Alexandros Tasianas

Technical Manager at Geolympus, Ltd.
tasianas@geolympus.com

The Northern Lights Project plans an onshore facility for temporary storage of CO₂ in Øygarden municipality, Hordaland, Norway. From this facility, the plan is to pump liquid CO₂ to a permanent offshore sub-seabed storage complex through a pipeline. Installing a CO₂ pipeline requires a zoning plan for the segments falling within the area of coverage of the Law on planning and construction. The assessment includes the 33 km inshore pipeline route stretching from the land facility at Ljøsøyana through Hjeltefjorden and Fedjeosen to a point one nautical mile seaward of the North Sea baseline, as well as the offshore part of the pipeline all the way to the CO₂ geological storage site. The proposed pipeline route crosses coastal waters housing spawning areas for herring and blue ling. The overall Environmental Risk Assessment approach applied here corresponds to a multistage approach that at the last stage expresses risk in terms of the likelihood of CO₂ leakage from the pipelines and of the severity of the environmental impact. For estimating the pipeline annual damage frequency we use the DNV and the Bayesian modelling approach which take into account various parameters, both internal and external, affecting the secure flow of CO₂ in the pipelines. The environmental risk associated with an accidental release from the pipeline, including a full rupture, at any point along the route is generally low, and within acceptance criteria for environmental influence set by the Northern Lights Project. Multiscale Modelling of Flow and Transport in Porous Media.

A methodology for 3D modeling of geological objects: Snøhvit site, Barents Sea.

Alexandros Tasianias

The Snøhvit reservoir and overburden have been an important location for testing CCS techniques. CO₂ injection into the Tubåen and lower parts of the Stø formations has taken place since 2008. Geological modeling, undertaken as part of the ECO₂ project activities, has allowed to model the local stratigraphy and any potential fluid flow pathways. The inclusion of geological features such as gas chimneys, faults, wells, pockmarks at the seabed and vertical fluid flow structures underlying the pockmarks in the models has also allowed to accurately simulate fluid flow through realistic geological models. As a consequence, fluid flow pathways and potential leakage scenarios have been proposed. Leaking of CO₂ from the Tubåen Formation (Fm) can partially migrate upwards to the Hekkingen Fm or less deep formations via the faults. If leaking reaches the tertiary faults, CO₂ can migrate through the Top kvitting Fm and maybe continue via pipe structures, faults or the clinofolds of the Torsk Fm and accumulate under the Upper Regional Unconformity (URU). The presence of pockmarks at the seabed could indicate further leakage between the URU and the seabed via vertical fluid flow structures underlying the pockmarks. Depending on the leakage mode, different types of geological model domain sizes and grid resolutions were created and populated with properties such as porosity (SP_{hi}), vertical permeability (k_v), horizontal permeability (K_h), anisotropy ratio (AnIso), Total Organic Carbon, [Cl], [CaCO₃], [CH₄] and various alkalinities. Modelling results indicate that the most likely sites for leakage, when the crust is subject to erosion-related compressive stresses, would be the faults. However we don't expect any major stress changes in the region in the next few Million years and the faults should remain sealing and thus prevent any CO₂ leakage. Simulation results indicate highest saturation values of CO₂ near the base of the overburden with no signs of any CO₂ reaching the seabed, thus reducing to a minimum the threat of any contamination to the seawater and marine wildlife.

Alexandros Tasianas

Technical Manager at Geolympus, Ltd

Alexandros Tasianas is a petroleum geoscientist and technical manager at Geolympus Ltd, a geological services company based in Nicosia, Cyprus. Dr. Tasianas holds an MSc in petroleum geosciences from Herriot Watt University, UK and a PhD within marine geophysics and Carbon Capture and Storage issues (CCS) from the Arctic University of Norway. In the past, he has been involved in several European CCS projects, such as ECO₂, Northern Lights, GEOMECS, NoveltiesOnCCS, where he focused on geological storage aspects of CCS and more particularly in constraining the potential pathways and the likelihood of leakage of CO₂ from these storage sites as well as from the CO₂ transport infrastructure. He has also been involved in various interdisciplinary projects across Europe, covering a wide spectrum of the geosciences, from CCS to Underground Coal Gasification (UCG), to Mechanics and the environment as well as to improving the dialogue on how to achieve a low- carbon society. His participation in these projects has contributed greatly in bringing forward CCS as an operational and economically viable technology in Europe and beyond. He has published several papers in reputed journals on themes related to marine geophysics, CCS and climate change, geological modeling and sustainable water management.





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Bagus Muljadi

GeoEnergy Research Centre, University of Nottingham,
Bagus.Muljadi@nottingham.ac.uk

The most challenging issues pertaining to storage and extraction of hydrocarbon in natural rocks hinge, in part, on tackling the huge disparity in spatial scales. Pore scale modelling of flow and transport in X-ray CT images has provided rich information about the micro-structures of flow; nevertheless, the manifestation of the vast knowledge extracted at this scale on the larger scales remain crude. This is in part due to heterogeneities in structure, and complex bio-geo-chemical processes involving solid dissolution. To circumvent these problems, new multiscale methods have been developed – each with its own strengths and weaknesses. In this talk, I will begin by presenting our works in pore-scale simulations, and then on the developments of two variants of multiscale method, one based on Multiscale Finite Element Method, and another on Continuous Time Random Walk. I also will touch upon issues related to experimental validations through MRI technologies.

Bagus Muljadi

GeoEnergy Research Centre, University of Nottingham, UK

Since Feb 2017, BPM has been an Assistant Professor in Chemical and Environmental Engineering, University of Nottingham. He is also an affiliated Assistant Professor at Virginia Tech, US. He is the director of Indonesia Doctoral Training Partnership. Bagus' research aims at overcoming the scientific challenges due to complex geometry and bio-geo-chemical processes; and a large disparity in scales in many subsurface flow and transport problems. He had postdoctoral trainings at Imperial College London (Earth Science Department), and Institut de Mathematiques de Toulouse, France. He is a Co-PI of NERC grant "NERC NE/R018030 - an integrated assessment of UK Shale resource distribution based on fundamental analyses of shale mechanical & fluid properties", and H2020 SECURE grant "H2020-LCE-2017-RES-CCS-RIA – Subsurface Evaluation of Carbon capture and storage and Unconventional Risk". Bagus' research combines a range of state-of-the-art modelling and experimental techniques to understand flow and transport in natural porous media.



Technical Overview of Carbon Capture and Storage Technologies & Risk Mitigation: Engineering Strategies for CO₂ Injection into Geological Formations

Dr Paul Eke
Executive Director, PEPRIME LIMITED
paul.eke@peprime.com

The first part presents current state of Carbon Capture and Storage (CCS) and recognises CCS for its cumulative capacity to mitigate climate change.

It covers technical overview of CCS technology {covering general overview of CCS chain ranging from; (a) Capture (Processes and Technology for CO₂ Capture in Power Plants, air, in the Cement and Concrete Industry and in the Iron and Steel Industry), (b) CO₂ after capture Conditioning, Compression and Transport, (c) Injection Processes and Technology, and (d) Brief overview of Utilisation, time permitting}.

Second part of the presentation covers CO₂ composition, CO₂ conditioning, compression, transport and injection processes and technology [with in-depth materials on 'Gas conditioning; purification, compression and liquefaction processes and technology for CO₂ transport], Infrastructure, vessel and pipeline technology for CO₂ transport, and of course CO₂ injection processes and technologies as well as long term storage and leakage risk mitigation.



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Dr Paul Eke, PhD, CEng, CEnv, FSEE

Executive Director, PEPRIME LIMITED

Dr Paul Eke is an Executive Director and a Principal Consultant at Peprime Limited, a diverse United Kingdom company engaging in Engineering, Energy & Environmental services. Dr Eke directs and manages operations & provides consultancy services to engineering, energy, environment, procurement and supply chain. He provided several technical and commercial leadership; led, supervised and mentored teams of engineers, consultants, managers and researchers to perform several projects globally. He works exclusively with professionals, partners, governments and other companies. His major role involves developing and directing core activities of the company. He coordinates network of partners & consultants globally to deliver client services.



He has broad experience with solid engineering skills gained from national & multi-national oil and gas as well as energy companies, and as an engineer, consultant, director or manager for various projects. He has acquired over two decades vast hands on experience and has delivered services in energy, environment, engineering, oil & gas, carbon capture and storage, business & technology development, research and project management. His research interest is in process engineering safety and the development of technologies for use in enhancing secure sequestration of CO₂ in geological formations.

Dr Eke is UK Engineering Council Chartered Engineer (CEng), Chartered Environmentalist (CEnv), Fellow of The Society of Environmental Engineers (FSEE), COREN Registered Engineer (Engr), Senior Member of American Institute of Chemical Engineers and Society of Petroleum Engineers. He holds a BEng (Hons) in Chemical Engineering from Enugu State University of Science & Technology, MSc in Oil and Gas Engineering from Robert Gordon University Aberdeen, and PhD in Civil and Environmental Engineering from the University of Edinburgh. He has authored books and published several technical papers and delivered numerous presentations at national and international seminars, workshops & conferences.



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Top surface morphology of CO₂ storage formations and its impact on the plume migration

Seyed Shariatipour

Coventry University, ab6995@coventry.ac.uk

A key challenge in the short-term for driving CCS to deployment is the development of effective geological storage, the major concern being the risk of leakage from the storage formation. In the case of sequestration in saline aquifers that is being promoted, CO₂ is less dense than brine, so when it is injected into the storage formation it will rise due to buoyancy, until it encounters a seal (caprock) and then migrates laterally beneath the caprock.

It is well known from the Sleipner project in Norway that CO₂ migration does not occur uniformly in all directions, due to irregularities in the top surface of the aquifer. If this seal is fractured, CO₂ could rise through overlying formations and reach the atmosphere or seabed, or contaminate drinking water.

It is therefore desirable to have a very good understating of the impact of the top surface morphology on the plume migration. In this talk I will present some of the current research activities performed at Coventry University to assess such impact on the migration of CO₂ in the storage formation. Fault Seal Analysis for Carbon Dioxide Storage within Offshore Pletmos Basin, South Africa.

Seyed Shariatipour

Coventry University, UK

Seyed Shariatipour completed his MSc in Petroleum Engineering at Heriot-Watt Institute of Petroleum Engineering in August 2010. Then, he started his PhD in the same University funded by Scottish Carbon Capture and Storage (SCCS) and Foundation CMG in November 2010. He joined Teesside University in September 2013 as Senior Lecturer in Reservoir Simulation and was MSc Petroleum Engineering Co-Course Director.



In January 2014, he joined Coventry University as Senior Lecturer in Petroleum Reservoir Management, and was MSc Petroleum and Environmental Technology Co-Course Director 2015-2017.

He leads Reservoir Engineering group in the Centre of Fluid and Complex System formally known as Flow Measurement and Fluid Mechanics Research Centre at Coventry University. His main research interests lie in the area of experimental and numerical studies of the multiphase fluid flow through porous media.

He studies the application of fluid flow in the oil and gas reservoirs as well as Carbon Capture and Storage (CCS). In particular, he is interested in the numerical simulation of CO₂ storage in deep saline formations and depleted hydrocarbon reservoirs, towards its effective and secure storage in these subsurface geological formations.



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The Unique Petroleum Geology Program, University of the Western Cape South Africa

Mimonitu Opuwari

University of the Western Cape, South Africa

The Department of Earth Science was started in 1962 as a first year geology service course in Geography Department, UWC. Current enrolment figure stands at 608 students (50/50) in Applied Geology and Environmental and Water Science Programs. Petroleum Geology was initiated at Honours level through the South African Petroleum Study Program (SAPS) and funded by the Upstream Training Trust, UTT as from 1998: UWC (Petroleum Geology); UCT (Geophysics) and US (Sedimentology). The Taught Masters Program started in 2013 to provide benchmarked skills for research and entry into the oil and gas sector; course is taught by leading experts. Our research projects are in Basin Analysis, Reservoir characterization, Biostratigraphy, Source Rock Maturity and Quality determination, Carbon Storage potentials among others.

Mimonitu Opuwari

University of the Western Cape, South Africa

Dr Mimonitu Opuwari is a senior lecturer in the Earth Sciences Department at the University of the Western Cape South Africa. He has about ten years research experiences in onshore and offshore basins of South Africa. Dr Opuwari is a visiting scientist at the Charney School of marine Geosciences University of Haifa Israel and he is currently the Africa Region Secretary of the American Association of Petroleum Geologists, AAPG. Opuwari is also a member of the Society of Petrophysicists and well Log Analysts, SPWLA; European Geoscience Union, EGU; Nigerian Association of Petroleum Explorationists, NAPE; Geological Society of South Africa; GSSA; and the South African Geophysicists Association, SAGA



Carbon dioxide: Capturing to Utilisation

Salam Titinchi

University of the Western Cape, South Africa

Carbon dioxide emissions have become a major concern as they are one of the contributing factors to the “green-house” effect. The increase in anthropogenic carbon dioxide is causing dramatic climate change and will continue to cause detrimental effects to the ozone layer if nothing is done to facilitate the problem.

An alternative capturing technological approach to combat this issue is using amine functionalized solid adsorbents. Solid adsorbents have received much attention due to the minimal amounts of energy required for the capturing technology.

Good adsorbent materials have in general, fast adsorption and desorption kinetics, large adsorption capacity and infinite regenerability and stability.

Recently, much effort has been put into separating carbon dioxide (CO₂) from flue gases linked to the combustion processes at fixed point sources. The development of solid sorbents for adsorption based on CO₂ capture has attracted much attention.

The world needs more solutions to climate change. The next steps are to design and engineer technologies to use CO₂ rather than fossil fuels to meet the chemical and fuel manufacture needs that can completely recycle carbon in a closed loop.

Salam Titinchi

University of the Western Cape, South Africa

Dr Titinchi is a full Professor and Catalysis Research Group Leader at the Department of Chemistry, University of the Western Cape, South Africa. He obtained his PhD from Indian Institute of Technology Roorkee in 2004. He served at University of Basrah (1984-2006) as Assistant Professor. He joined the University of the Western Cape in 2005.



Titinchi has more than 30 years of lecturing experiences and post-graduate supervision. He has authored and co-authored over 60 peer reviewed journal articles and edited a book and authored three book chapters. Titinchi is NRF-C2 rated researcher and has H Index of 18 according to Scopus.

Dr Titinchi serves as a member of the Editorial Board for Mini-review in Medicinal Chemistry.

He organized the Carbon Capture workshop at UWC in 2014 and 2015. He has international research collaborations with Roskilde and Copenhagen Universities, Denmark, Johannes Gutenberg University, Germany, Missouri and Howard University, USA and the Norwegian University of Science and Technology, Norway. He was a visiting professor at University of Missouri under UM-UWC Academic Exchange programme (UMSAEP linkage program) 2014. Titinchi is the initiator of UWC-Howard University GEAR-UP program (Global Education, Awareness and Research Undergraduate Program).

Dr Titinchi research interests lie in the field of heterogeneous catalysis and green chemistry. This entails designs for the synthesis of organic-inorganic materials, coordination polymers, organometallic complexes and advanced nano-materials for environmental applications particularly CO₂ capture and water purification.

Green Chemistry Synthesis of Nanosynthesis of Nano-Scaled Oxide/Graphene Systems for CO₂ Detection

Maxwell Amponsah-Dacosta

University of the Western Cape, South Africa

Anthropogenic carbon dioxide (CO₂) is principally emitted from the burning of fossil fuels mainly for electric power generation, raising alarming issues of climate change. South Africa, a country dependent on coal energy for 93% of its electricity, generates approximately 400 million tonnes of CO₂. It is ranked within the top 20 most carbon-intensive economies on a global scale.

Geological carbon storage, which forms part of the Carbon Capture and Storage (CCS) technology, is an expanding technique aimed at reducing CO₂ footprint. The study seeks to explore the CO₂ storage capacity of the scarcely defined Pletmos Basin, located along the south coast of South Africa. A series of faults subdivide the Basin into half-grabens which exhibit different tectonic and sedimentary histories.

An investigation into the evidence of deep saline formations in the Pletmos Basin is essential, as saline formations contain most of the global geologic storage capacity for CO₂. The study aims to examine the potential of CO₂ storage within the offshore Pletmos Basin of South Africa with the primary focus on fault characterization.

A successful fault seal analysis will contribute towards a detailed understanding of fault rock properties within the basin. This can be achieved by evaluating the distribution of stratigraphy against faults by integration of four key data source (seismic interpretation, well data interpretation, 3D structural modelling and engineering data).

Maxwell Amponsah-Dacosta

University of the Western Cape, South Africa

Maxwell Amponsah-Dacosta is a PhD candidate at the University of the Western Cape (UWC), South Africa. He has a broad research background in Environmental, and Applied Geology.



Between 2011 and 2013, he worked with the geological consulting firm, Shango Solutions, in Johannesburg, South Africa.

He also has a Master of Science Degree in Applied Geology from the University of Cape Town, where he worked with Prof David Reid in exploring the mineralogical characteristics of South African mine tailings for the purposes of mineral carbonation. The outcome of this research project has garnered much interest in the Mineral Carbonation enterprise.

Currently, Maxwell is conducting an exciting research as part of his PhD in Petroleum Geosciences at UWC, with the main focus on fault seal analysis for carbon dioxide storage within the offshore Pletmos Basin of South Africa. For this project, he will be working closely with research collaborators from Coventry University (United Kingdom) and the University of Haifa (Israel), with sponsorship from the South Africa Centre for Carbon Capture and Storage.

Mass Separating Agent Targeting during CO₂ Capture Using an Improved Mass Integration Technique

Kelvin O. Yoro¹, Adeniyi J. Isafiade², Michael O. Daramola^{1,*}

¹School of Chemical & Metallurgical Engineering, University of the Witwatersrand, Johannesburg, South Africa. ²Department of Chemical Engineering, University of Cape Town, South Africa.

A number of advances for synthesizing mass exchanger networks (MENs) intended for utility targeting have been reported using simultaneous techniques. Most of the current methodologies reported in literature for mass exchanger network synthesis are dedicated to single component problems using simultaneous approaches and less attention have been given to mass exchanger network synthesis with multi-component problems using sequential techniques. Till date, it has not been easy to systematically choose between the process and available external mass separating agents (MSA) in mass exchanger network synthesis during the adsorption of CO₂. In this study, a new technique for targeting external mass separating agents (sorbents) for material minimization is presented alongside its detailed network design. The proposed technique was tested using a CO₂ adsorption problem that involves two mass separating agents that overlap. A thermodynamic analysis of the CO₂ adsorption process was outlined in this study using a composition interval method. Unlike previous studies for mass exchanger network synthesis, this contribution considers a trade-off between the process MSA (S1) and external MSA (S2) to determine the minimum amount of external MSA required for the CO₂ capture process. A typical case study involving the preferential adsorption of CO₂ was adapted from open literature to demonstrate the effectiveness of the synthesized mass exchanger network during CO₂ capture. Results from this study establish that mass integration via process synthesis is an effective strategy to minimize the quantity of external utilities and MSAs required during the adsorption of CO₂ from a rich stream of flue gas.



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Kelvin Yoro

University of the Witwatersrand, Johannesburg, South Africa

I am currently a 3rd year PhD student in the school of Chemical and Metallurgical Engineering at University of the Witwatersrand, Johannesburg, South Africa. I obtained my MSc Eng. degree in Chemical Engineering from the same university in 2017. As a researcher, I have authored and co-authored a few scientific papers published in referred peer-reviewed journals and presented my research findings at various local and international conferences. My core research interests are in the areas of CO₂ capture, storage and utilization, separation processes, process optimization, sustainable and renewable energy as well as process modelling, simulation and control.

Reservoir Characterisation for Carbon Capture storage: Case Study of the Orange Basin

Nehemiah Dominick¹, Mimonitu Opuwari¹, Nicolas Waldmann²

¹ University of the Western Cape, South Africa

² University of Haifa, Israel

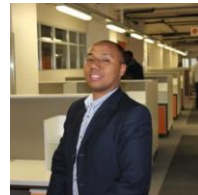
Natural gas reservoirs are obvious targets for carbon sequestration by direct carbon dioxide (CO₂) injection by virtue of their proven record of gas production and integrity against gas escape. Carbon dioxide undergoes a large change in density as CO₂ gas passes through the critical pressure at temperatures near the critical temperature. This feature makes CO₂ a potentially effective cushion gas for gas storage reservoirs. This paper investigates the feasibility of carbon dioxide disposal in natural reservoirs. Reservoirs are a practical storage site for the carbon dioxide, because the presence of the hydrocarbons that were trapped in the subsurface for thousands to millions of years proves that they can retain the carbon dioxide safely. The storage capacity of depleted gas reservoirs depends on numerous factors reviewed in this paper.



Nehemiah Dominick

University of the Western Cape, South Africa

Phd Candidate (Petroleum Geoscience) studying at the University of the Western Cape. He is currently serving as the President of the AAPG UWC student chapter.



Petrophysical evaluation and fluid substitution modelling of the Upper shallow Marine sandstone reservoirs in the Bredasdorp Basin, South Africa

Moses Magoba

University of the Western Cape, South Africa

The study focused on the Upper Shallow Marine sandstone reservoirs of 2 selected wells (E-G1 and F-A13) in the Bredasdorp Basin, offshore, South Africa. The integration of Petrophysics and rock physics (Gassmann fluid substitution) was applied for reservoir characterization. The overall objective of the study was to calculate the volume of clay, porosity, water saturation, permeability and the application of the Gassmann fluid substitution modelling to determine the effect of different pore fluids (brine, oil, and gas) on the acoustic properties (V_p , V_s , and density). The average volume of clay, porosity, water saturation, and permeability values ranged from 13.8%-17.4%, 9.2%- 16.6%, 33.9%- 30.4% and 1.129mD- 151.8mD respectively. The fluid substitution modelling was applied for the calculation of the effects of fluid substitution on seismic properties using rock frame properties. The fluid substitution affected the rock property significantly. The V_p and density decrease when brine was substituted with gas in well F-A13. Well E-G1 contains both oil and gas and therefore showed a notable decrease in V_p and density from brine to oil and from oil to gas respectively. The V_s remained unaffected in all the wells.



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Moses Magoba

University of the Western Cape, South Africa

Moses Magoba is a Ph.D. student from the Earth Sciences department at the University of the Western Cape. His research interests include petrophysics and rock physics. He recently submitted his Ph.D. thesis and currently waiting for his examination results with the anticipation of graduating in April 2019.



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Geological Modelling for Carbon Storage Opportunities in the Orange Basin South Africa

Jade Aiden Holtman

University of the Western Cape, South Africa

This study investigates the viability of the sedimentary deposits in the Northern Orange basin for Carbon Dioxide sequestration. A combination of geological modelling, petrographic and geochemical techniques are used to investigate this scenario after an initial seismic-well tie had been performed to match the formation tops in Well AF-1 with the 3D seismic volume acquired in this basin in 2009.

Jade Aiden Holtman

University of the Western Cape, South Africa

- MSc degree in Petroleum Geology with emphasis on global Warming, dealing with Carbon dioxide sequestration.
- Completed an internship program with the National Research Foundation. Dealing with Geographical information systems (GIS) and other water quality and soil programs such as Aquachem.
- BSc Honours Applied Geology Research project topic: Hydrocarbon potentials of Hoiho-1c well based in New Zealand.



Courses completed:

- Petroleum Geology (Mark achieved: A)
- Economic Geology & Exploration techniques (Mark achieved: B)
- Research project (Mark achieved: C)
- Applied Geochemistry (Mark achieved: C)
- Ore Deposit Modelling (Mark achieved: C)
- BSc Applied Geology (completed)



Investigation of the carbon storage potential of the Sundays River Trough in the Algoa Basin

Tshiamo Moleele

University of the Western Cape, South Africa

Carbon capture and storage (CCS) is one of the technical approaches that can be used to mitigate global climate change in fossil fuel dominated countries such as South Africa. The South African Centre of Carbon Capture and Storage developed South Africa's CO₂ geological storage Atlas where they found South Africa's total storage is in the Mesozoic basins along the coast. Algoa Basin was identified as one of the best potential storage site.

This paper will investigate the amount of carbon storage potential CO₂ can be stored in the Sundays River Trough. To achieve this the basin suitability will be determined by volumetric analysis that is derived from the US- Department of Energy's National Energy Technology Laboratory (US-DOE-NETL) looking at the seismicity, size and depth of the basin, the faulting intensity and how accessible it is. To estimate the storage capacity the possible sites in the Sundays Rivers will be examined using the CO₂ Storage Prospective Resource Estimation Excel aNalysis (CO₂SCREEN) by looking at the pore volume, CO₂ density, trap types, seal capacity and thickness, faults, permeability and porosity and the depth to top reservoir.

Tshiamo Moleele

University of the Western Cape, South Africa

First year masters candidate student in Applied Geology. Completed undergraduate degree and honours degree in Applied Geology at the University of the Western Cape. Currently working for Marquette University South Africa Service Learning Programme as a resident assistant. Software experience in ArgGIS, Maptek, Surfer, Petrel, Download Explorer and IoGas.



Currently the President of the Golden Key International Honours Society UWC chapter and the Vice-President of the Society of Petroleum Engineers UWC chapter. Have been awarded the Top100 Future Leaders in South Africa in 207 by GradConnection. I serve on the NEC executive committee of ACCESS Habitable Planet Workshop as the Western Cape Representative, an organisation founded by George Philander in 2008.